

Report Title

2010 Insect Resistance Management Compliance Assurance Program Report
for Corn Borer-Protected Bt corn, Corn Rootworm-Protected Bt corn, and Corn Borer/
Corn Rootworm-Protected Stacked Bt corn

Data Requirement

Condition of Registration for Plant-incorporated Protectants Produced By:

Corn Borer-Protected Bt Corn (EPA Reg. Nos. 524-489, 68467-2, 67979-1, and 29964-3),
Corn Rootworm-Protected Bt Corn (EPA Reg. Nos. 524-528, 524-551, 68467-5, 67979-
5, and 29964-4), and
Corn Borer/Corn Rootworm-Protected Stacked Bt Corn (EPA Reg. Nos. 524-545, 524-
552, 524-576, 68467-6, 67979-8, and 29964-5)

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Report Completion Date

January 26, 2011

Registrant Submitting

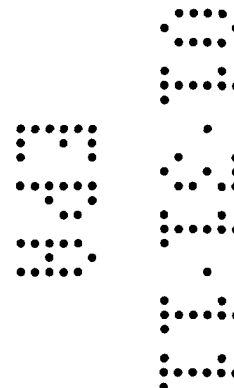
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Project ID

CAP-2010

Volume 1 of 1



Statement of No Data Confidentiality Claims

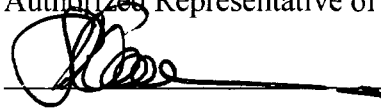
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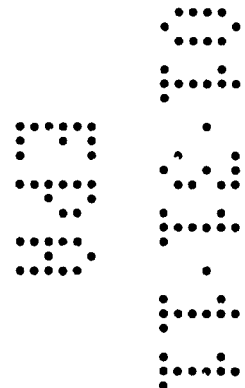
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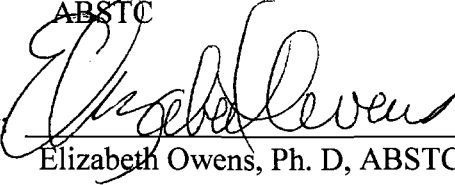
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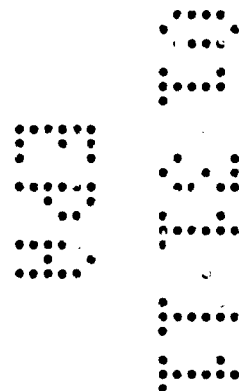
GLP Compliance Statement

This report does not meet the U.S. EPA Good Laboratory Practice requirements as specified in 40 CFR Part 160, as it is not a study but a report summarizing information compiled from third party, anonymous grower surveys and on-farm assessments by the ABSTC.

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Executive Summary

The 2010 Compliance Assurance Program Report, compiled by the Agricultural Biotechnology Stewardship Technical Committee (ABSTC), describes industry-coordinated compliance assurance activities for insect resistance management (IRM) requirements associated with corn borer-protected Bt corn, corn rootworm-protected Bt corn and corn borer/corn rootworm-protected stacked Bt corn.¹ This report includes a summary of the results of the 2010 third-party grower survey, 2010 on-farm assessments, compliance assurance program (CAP) activities for the prior year, and plans for the CAP during 2011.

The third-party, anonymous IRM grower survey² has been designed and conducted each year since 2000 by the independent marketing research firm, Market Probe, Inc., of St. Louis, MO. ABSTC has sponsored annual grower surveys for corn borer-protected Bt corn since 2000, and for corn rootworm-protected Bt corn and stacked Bt corn since 2006.

The 2010 grower survey indicates that the majority of growers adhered to the refuge size requirement for each Bt product type (n = number of growers surveyed):

- 76% for corn borer-protected Bt corn (n = 269)
- 73% for corn rootworm-protected Bt corn (n = 54)
- 69% for stacked Bt corn (n = 536)

And to the refuge distance requirement for each Bt product type:

- 87% for corn borer-protected Bt corn (n = 269)
- 67% for corn rootworm-protected Bt corn (n = 54)
- 63% for stacked Bt corn (n = 536)

As with past surveys, further analysis of the survey results revealed that a significant portion of the growers not adhering to the refuge size and distance requirements attempted to meet the requirements by planting a refuge between 15-20% of their total acres and/or ensuring that most of their Bt fields met the refuge distance requirement.

A total of 3160 on-farm IRM assessments were conducted in 2010 with growers representing a range of farm sizes and states. Intended to be a mechanism for finding

¹ Hereafter referred to as “stacked Bt corn”.

² Hereafter referred to as “grower survey”, “internet survey” or “survey”.

non-compliant growers, the on-farm assessment program identified growers who were out of compliance with the IRM requirements across all three product types:

- Corn borer-protected Bt corn: 111 of 830 growers assessed were found to be out of compliance.
- Corn rootworm-protected Bt corn: 9 of 58 growers assessed were found to be out of compliance.
- Stacked Bt corn: 368 of 2272 growers assessed were found to be out of compliance.

In accordance with the CAP's Phased Compliance Approach, all growers who were found out of compliance in 2009 were contacted with additional educational materials and a follow-up assessment in 2010, which resulted in the vast majority complying with the requirements during the 2010 growing season. Follow-up assessments in 2010 of growers with significant deviations in 2009 resulted in one (1) grower being found out of compliance a second time and denied access to the investigating company's Bt corn product for the 2011 planting season. The Phased Compliance Approach continues to be an effective approach for bringing non-compliant growers back into compliance.

ABSTC continues to collaborate with other key stakeholders in whose interest it is to preserve the efficacy of the technology. ABSTC is working with the National Corn Growers Association (NCGA) to ensure that its membership and networks are fully informed of refuge requirements and the CAP. Extension entomologists and other external educators are being engaged to share key findings and key messaging. ABSTC and member companies will closely review the survey data and enhance education efforts as needed.

Section I: Introduction

The 2010 CAP Report, compiled by ABSTC, describes industry-coordinated compliance assurance activities for IRM requirements associated with corn borer-protected Bt corn, corn rootworm-protected Bt corn and stacked Bt corn. The IRM Stewardship Subcommittee of ABSTC contributed to this report and the activities described herein. Membership of this Subcommittee consists of the following Bt corn plant-incorporated protectant (PIP) registrants: Dow AgroSciences LLC; Monsanto Company; Pioneer Hi-Bred International, Inc., a DuPont Business; and Syngenta Seeds, Inc.

This report represents the fifth year of ABSTC activities covering corn borer-protected, corn rootworm-protected and stacked Bt corn products.³ As described in the applicable CAP,⁴ the registrants of insect-protected Bt corn PIPs use an anonymous grower survey to measure adherence to the IRM requirements and an on-farm IRM assessment program to find non-compliant growers.

The grower survey has been conducted since the inception of the corn borer-protected Bt corn IRM program (2000), and had been a phone-based survey through 2006. Upon the recommendation of Market Probe, and following consultation with the Agency in 2007,⁵ an internet-based survey approach was incorporated to reduce complexity involved with surveying multiple Bt traits on the phone. Given the success with the internet-based survey the last three years, this approach was again utilized in 2010.

An ABSTC-coordinated on-farm IRM assessment program was initiated in 2002 by each registrant as part of the EPA-mandated CAP for corn borer protected Bt corn.⁶ In 2006, the on-farm IRM assessment program was adapted to include corn rootworm-protected Bt corn and stacked Bt corn products.

In fulfillment of the registration conditions of corn borer-protected Bt corn, corn rootworm-protected Bt corn and stacked Bt corn registrations, this report includes a summary of the results of the 2010 third-party grower survey, 2010 on-farm assessments, and CAP activities for 2011.

Section II: Third Party IRM Grower Survey

1. Methodology

The objectives of the grower survey are to: i) determine the level of adherence to the IRM requirements, ii) measure awareness of the IRM requirements, and iii) obtain grower feedback for improvement of educational and compliance programs. The methodology was the same for all product types.

As in previous years, the survey was conducted by an independent third party (Market Probe, St. Louis, MO) who was contracted by ABSTC. A statistically representative

³ Prior to 2006, CAP activities for corn rootworm-protected Bt corn and stacked Bt corn were the responsibility of the registrant for each product.

⁴ Refer to the Bt Corn IRM CAP (submitted to EPA on September 24, 2002) and individual registrant CAPs submitted in fulfillment of their rootworm-protected Bt corn and stacked Bt corn registrations.

⁵ E-mail exchange and telephone discussions between David Guyer, representing ABSTC, and Mike Mendelsohn, United States Environmental Protection Agency (EPA)'s Biopesticides and Pollution Prevention Division (BPPD), in June 2007.

⁶ Refer to 2003 IRM CAP Report for Corn Borer-Protected Bt corn (submitted to the EPA on January 29, 2004) for a comprehensive description of the on-farm assessment methodology. MRID 473396-01.

sample of Bt corn growers (minimum of 600 growers) was recruited to complete the survey to ensure that the findings of the survey are useful in drawing inferences about the grower community. The growers were selected at random within EPA-requested regions by Market Probe from customer lists provided by the registrants. The survey thereby provides statistically valid measures of grower knowledge and adherence to refuge requirements, and enables comparisons to be made across years and among regions.

Respondents were randomly selected and remained anonymous to protect the integrity of the responses. Respondents were required to: i) be actively involved in farming, ii) be the individual primarily responsible for decisions concerning seed purchase for their operation, and iii) not have worked for a farm chemical manufacturer, distributor or dealer, or for a seed company other than as a farmer/dealer, which also applied to family members. In addition, to ensure the data is representative of growers who plant the majority of corn in the US, participating growers were required to have planted a minimum of 200 acres of corn in 2010 (or a minimum of 100 acres in the cotton-growing region) with a minimum of 50 acres of Bt corn.

Selected growers were initially contacted by phone to make sure that they were qualified for the survey and to obtain their agreement to participate. Qualified respondents were then directed to the internet, where the IRM questionnaire was available online. Once online, growers were prompted to respond to a series of questions about their Bt corn planting practices and awareness of IRM stewardship requirements. This approach allowed the growers time to complete the survey at their own pace, helping to ensure that they understood what was being asked, and allowed time for the growers to check their planting records if necessary to confirm that they were responding accurately. The survey questionnaire, like the phone survey used previously, requested information in a manner such that the growers did not know that it was an IRM compliance survey until sufficient information had been collected for the assessor to determine adherence to the refuge requirements.

The number of growers participating in the survey was determined as follows to ensure a statistically significant representation for both (i) overall sample size, and (ii) product type:

- (i) A minimum of 600 growers completed the internet survey, and
- (ii) A minimum of 200 growers completing the survey planted corn borer-protected Bt corn, a minimum of 200 growers planted stacked Bt corn, and a minimum of 50 growers planted rootworm-protected Bt corn.

To address BPPD's request⁷ to provide survey data on a regional basis, Market Probe assessed a statistically representative number of growers in three regions. These regions were defined by ABSTC and conveyed to BPPD in the minutes of a May 21, 2009 meeting between BPPD and the ABSTC IRM Stewardship Subcommittee.⁸ The regions and the target number of growers from each region are outlined below:

- A. Eastern Corn Belt (250 growers): primarily Indiana, Illinois, Wisconsin, Ohio, Michigan
- B. Western-central Corn Belt (250 growers): primarily Iowa, Nebraska, Minnesota, South Dakota, Missouri, Kansas
- C. Cotton-growing region (100 growers): as defined by EPA in Bt corn registrations

To obtain statistically valid national results, survey results from the three regions were weighted according to the proportion of total US corn acres in each region.

Growers were recruited for the survey between July 12th and September 2nd and the internet-based portion remained open for completion until September 7, 2010.

2. Results

a. Corn Borer-Protected Bt Corn

i. Refuge Requirements

A total of 269 growers who planted a corn borer-protected Bt corn product in 2010 completed the internet-based IRM grower survey. These growers may or may not have also planted a stacked Bt corn product containing both a corn borer-protected and corn rootworm-protected trait. The margin of error for the percentage adherence to refuge requirements was +/- 6.0%.

As illustrated in Figure 1, overall adherence to both the refuge size requirement and the refuge distance requirement remained above 70% in 2010. Seventy-six percent (76%) of the growers planting corn borer-protected Bt corn met the refuge size requirement, and an additional 11% made a good faith effort and planted greater than 15% corn borer refuge. On average, 87% of growers planted refuge corn within ½ mile of each corn borer-protected Bt corn field. Five percent (5%) of growers surveyed failed to plant a refuge for their corn borer-protected Bt corn.

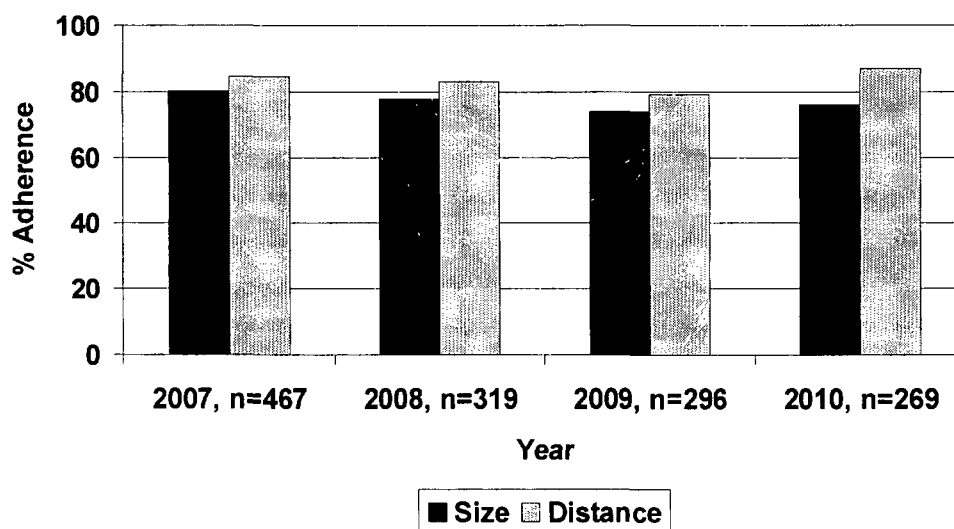
⁷ EPA Review of ABSTC's 2007 and 2008 Corn IRM CAP (April 15, 2009).

⁸ Minutes of Meeting between BPPD and the ABSTC IRM Stewardship Subcommittee to Discuss 2007 and 2008 IRM CAP Reports (submitted by Stanley H. Abramson on behalf of the members of the ABSTC IRM Stewardship Subcommittee to Mr. Mike Mendelsohn on August 4, 2009).

Responses to survey questions about each field on a grower's farm revealed that 91% of all fields planted to corn borer-protected Bt corn had a refuge planted within the required ½ mile distance. Three percent (3%) of all fields had a refuge beyond ½ mile; while 6% of all corn borer-protected fields had no corn borer refuge associated with them.

On a regional basis (Figure 2), 71% and 81% of growers reported planting the correct refuge size in the eastern and western regions of the Corn Belt, respectively. In the cotton-growing region, 49% of growers met the refuge size requirements. Adherence to the distance requirements was at 83% and 90% in the eastern and western Corn Belt, respectively. In the cotton region, 70% of surveyed growers planted all of their fields within the appropriate distance.

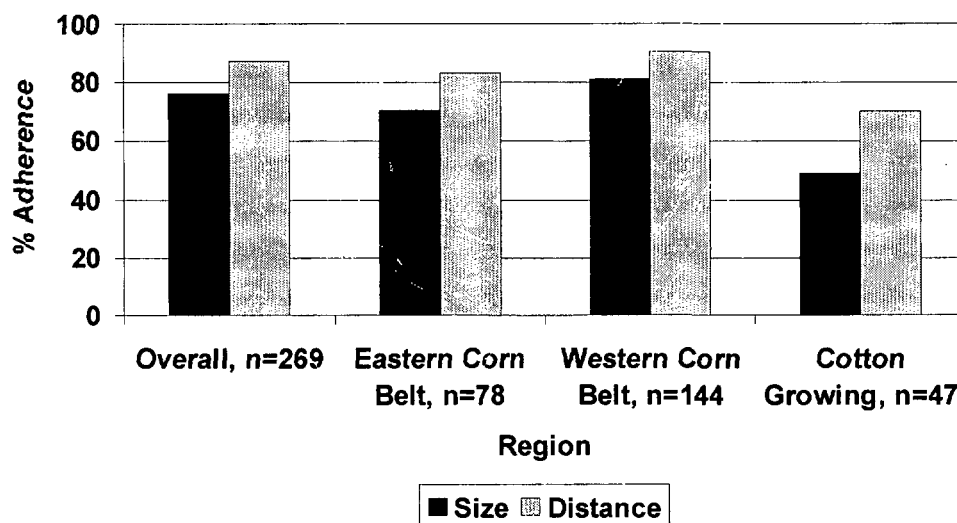
Figure 1. 2007-2010 Grower Adherence to the Size and Distance Requirements for Corn Borer-Protected Bt Corn (n = number of respondents)



ii. Grower Awareness of IRM Requirements

As with previous years, the vast majority of growers surveyed (94%) said that they were aware of requirements for managing insect resistance. When asked on an unaided basis what they recalled about the IRM requirements, 65% of growers correctly answered that a 20% refuge (50% in the cotton-growing regions) is needed for corn borer-protected Bt corn. On an unaided basis, 82% of growers knew that the corn borer refuge must be planted within ½ mile of corn borer-protected Bt corn.

Figure 2. Grower Adherence to the Size and Distance Requirements for Corn Borer-protected Bt Corn by Region (n = number of respondents)



iii. IRM Education

Results from the education portion of the survey remain unchanged from recent years. Ninety-two percent (92%) of growers stated that insect resistance management plans for Bt corn are somewhat or very important. Growers indicated that: (i) seed companies and their dealers are by far the most important sources of IRM information (93% and 95%, respectively), (ii) they are receiving multiple sources (e.g., technical guide, conversation with company representative) of IRM information (94% of growers received multiple sources), and (iii) they had enough information at the time of planting to establish and manage a Bt corn refuge (80% of growers).

b. Rootworm-Protected Bt Corn

i. Refuge Requirements

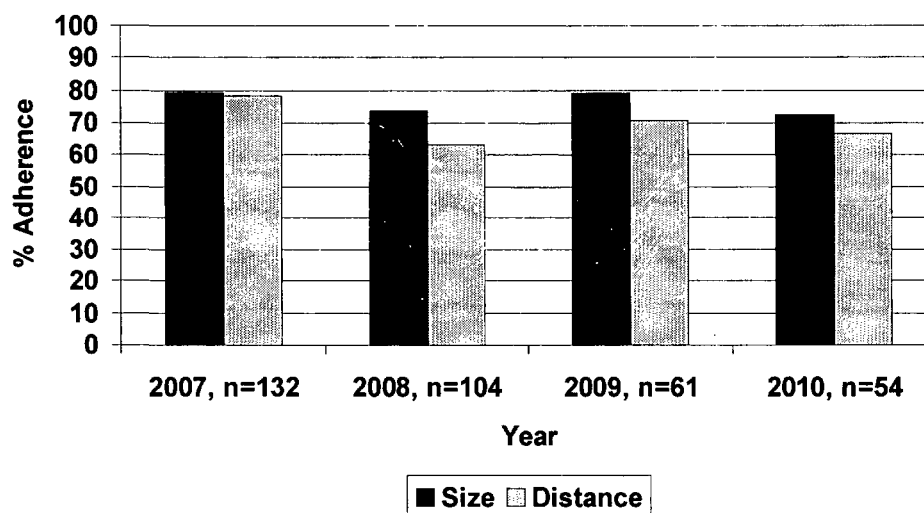
In 2010, 54 growers of corn rootworm-protected Bt corn completed the internet survey. These growers may or may not have also planted a stacked Bt corn product containing both a corn borer-protected and corn rootworm-protected trait. The margin of error for the percentage adherence to refuge requirements was +/- 13.3%.

Seventy-three percent (73%) of the growers planting rootworm-protected Bt corn met the size requirement (Figure 3), and a number of others made a good faith effort – an additional 10% of growers surveyed planted at least a 15% rootworm refuge on farm. On average, 67% of growers planted refuge corn within or adjacent to each rootworm-protected Bt corn field. Nine percent (9%) of growers surveyed failed to plant a refuge for their rootworm-protected Bt corn.

Responses to survey questions about each field on a grower's farm revealed that 70% of fields planted to rootworm-protected Bt corn had a refuge planted within the required distance (within or adjacent). Twelve percent (12%) of all rootworm-protected fields had a refuge beyond the required distance (i.e., not adjacent but nearby), while 18% of the fields had no refuge associated with them.

A regional breakdown of rootworm-protected Bt corn responses is not available due to the insufficient sample size of respondents.

Figure 3. 2007-2010 Grower Adherence to the Size and Distance Requirements for Corn Rootworm-Protected Bt Corn (n = number of respondents)



ii. Grower Awareness of IRM Requirements

Ninety-seven percent (97%) of corn rootworm-protected Bt corn growers surveyed in 2010 said they were aware of requirements for managing insect resistance. When asked on an unaided basis what they recalled about the IRM requirements, 33% of growers correctly answered that a refuge size of at least 20% is needed for rootworm-protected Bt corn. On an unaided basis, 22% of growers knew that the rootworm refuge must be planted within or adjacent (separated by only a road, path or ditch) to the corn rootworm-protected Bt corn field.

iii. IRM Education

Results from the education portion of the survey remain unchanged from recent years. Ninety-four (94%) of growers stated that insect resistance management plans for Bt corn are somewhat or very important. Growers indicated that: (i) seed companies and their dealers are by far the most important sources of IRM information (89% and 97%, respectively), (ii) they are receiving multiple sources (e.g., technical guide, conversation

with company representative) of IRM information (97% of growers received multiple sources), and (iii) they had enough information at the time of planting to establish and manage a Bt corn refuge (71% of growers).

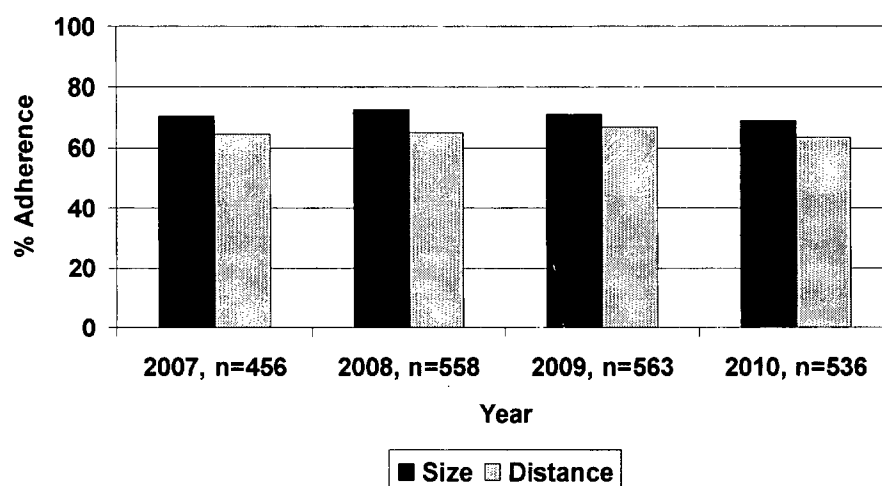
c. Stacked Bt Corn

i. Refuge Requirements

A total of 536 growers planting stacked Bt corn were surveyed in 2010. These growers may or may not have also planted corn borer-protected Bt corn and/or corn rootworm-protected Bt corn products on their farm. These growers were assessed for their adherence to refuge requirements for both their corn borer and corn rootworm traits. The margin of error for the percentage adherence to refuge requirements was $\pm 4.2\%$.

Results of the 2010 survey are presented in Figure 4. Sixty-nine percent (69%) of the growers planting stacked Bt corn met the size requirement, and a number of others made a good faith effort – 10% of growers surveyed planted at least a 15% corn borer and rootworm refuge on farm. Sixty-three percent (63%) of growers met the distance requirements for both corn borer and corn rootworm components of their stacked Bt corn. Twelve percent (12%) of growers surveyed who planted stacked Bt corn failed to plant a refuge for the corn borer and/or corn rootworm components of stacked Bt corn.

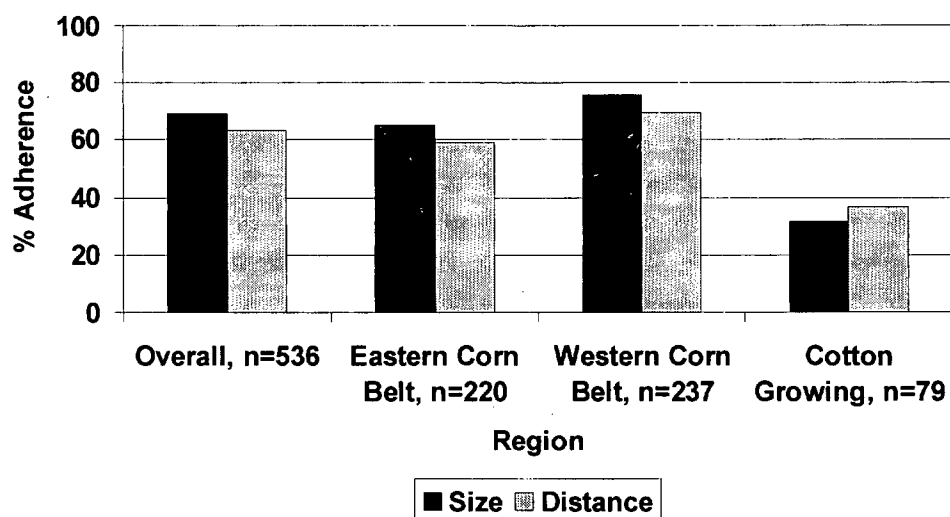
Figure 4. 2007-2010 Grower Adherence to the Size and Distance Requirements for Stacked Bt Corn (n = number of respondents)



Responses to survey questions about each field on a grower's farm revealed that 73% of fields planted to stacked Bt corn had both a corn borer and a corn rootworm refuge planted within the required distance. Thirteen percent (13%) of the stacked Bt fields had a refuge beyond the required distance, while 14% of the fields had no refuge for the corn borer and/or rootworm component associated with them.

Regionally (Figure 5), 65% and 76% of growers reported planting the correct refuge size in the eastern and western regions of the Corn Belt, respectively. In the cotton-growing region, 32% of growers met the refuge size requirements. Adherence to the distance requirements for both the corn borer and corn rootworm components of stacked Bt corn was at 59% and 69% in the eastern and western Corn Belt, respectively. In the cotton-growing region, 37% of surveyed growers planted all of their fields within the appropriate distance of refuge.

Figure 5. Grower Adherence to the Size and Distance Requirements for Stacked Bt Corn by Region (n = number of respondents)



ii. Grower Awareness of IRM Requirements

Ninety-four percent (94%) of growers planting stacked Bt corn surveyed in 2010 said they were aware of requirements for managing insect resistance. When asked on an unaided basis what they recalled about the IRM requirements, 61% of growers correctly answered that a refuge size of at least 20% (50% in the cotton-growing regions) is needed for the corn borer-protected component of stacked Bt corn, and 56% of growers correctly answered that a refuge size of at least 20% is needed for the rootworm-protected component of stacked Bt corn. On an unaided basis, 82% of growers indicated that the refuge for corn borer must be $\frac{1}{2}$ mile or less from the corn borer-protected Bt corn, while 27% of growers reported that the refuge for corn rootworm must be within the same field or in an adjacent field.

iii. IRM Education

Results from the education portion of the survey remain unchanged from recent years. Ninety-two (92%) of growers stated that insect resistance management plans for Bt corn

are somewhat or very important. Growers indicated that: (i) seed companies and their dealers are by far the most important sources of IRM information (91% and 91%, respectively), (ii) they are receiving multiple sources (e.g., technical guide, conversation with company representative) of IRM information (94% of growers received multiple sources), and (iii) they had enough information at the time of planting to establish and manage a Bt corn refuge (79% of growers).

d. Discussion

As with previous years, the objectives of the IRM grower survey were met - a statistically valid data set that was proportional to product type adoption was analyzed. Overall, the majority of growers surveyed adhered to the refuge requirements, and the 2010 results are consistent with the results of the previous three years even as adoption of stacked Bt corn has steadily increased in recent years. The main reasons for lack of adherence identified by growers planting all product types included inconvenience (36% to 47% of respondents), economic considerations (20% to 21%) and lower yields (13% to 14%).

It is important to recognize that, of those growers who were categorized as not adhering to the refuge requirements, approximately 10% of them made a good faith effort to meet the requirements and planted between a 15% and 20% refuge on their farm. Perhaps even more important due to the biological significance, the survey found the majority of Bt corn fields (between 82% and 94%) were planted with a refuge.

The survey data continues to indicate that adherence to refuge distance requirements, specifically with Bt corn products containing rootworm traits, is more challenging to meet than the size requirement. ABSTC will continue to promote the planting of non-Bt corn within or adjacent to Bt corn fields to increase compliance with the distance requirements.

Regionally, the survey findings were similar for growers planting corn borer-protected Bt corn and stacked Bt corn in the eastern and western Corn Belt regions. There were no significant differences between the two Corn Belt regions across these product types that would suggest one region should be treated differently from the other. In the cotton-growing region, growers do not adhere to refuge requirements to the same extent that they do in the Corn Belt. ABSTC will leverage new educational and promotional materials (as referenced in the Conclusion section) to increase grower awareness, understanding, and proper execution of IRM requirements.

Overall grower awareness of the refuge requirements remains very high (~95%) across traits. However, when asked on an unaided basis, fewer growers were able to recall what they knew about the specific requirements (e.g., 82% of growers recalled the correct distance requirement for corn borer-protected Bt corn, 61% of growers recalled the correct size requirement for stacked Bt corn, and 22% of growers recalled the correct distance requirement for rootworm-protected Bt corn). Additionally, these data show a 10% decrease of growers reporting they have sufficient IRM information to meet the refuge requirements at planting. Consistent with the terms and conditions of the amended registrations, registrants will enhance the refuge education program throughout the seed delivery channel.

Section III: IRM On-Farm Assessments

1. Methodology

The objective of the on-farm IRM assessment program is to identify non-compliant growers and bring them back into compliance through the Phased Compliance Approach. Unlike the IRM online grower survey, the on-farm assessment program is not a statistical tool for measuring the level of adherence with the IRM requirements.

Registrants and their seed company partners independently coordinate the on-farm assessment activities each year. Beginning in 2010, two-thirds (2/3) of the growers scheduled for an assessment were selected from areas where pest resistance risk is highest (i.e., high Bt corn penetration and target pest pressure). The remaining one-third (1/3) of the growers were randomly selected in areas where the registrants have Bt corn products being sold. Growers receiving “first time” on-farm assessments (i.e., they were not assessed the previous year) were selected from individual company customer lists and included a range of farm sizes. Assessments are conducted on a product type basis (e.g., corn borer-protected, rootworm-protected, corn borer and rootworm-protected). As growers often plant more than one product type, it is therefore possible to complete more than one assessment per grower. For example, an individual planting corn borer-protected Bt corn and stacked Bt corn could receive two unique assessments. The number of unique product type assessments varied due to the market size of each product type. Growers found to be out of compliance in 2009 received a follow-up on-farm assessment in 2010 (i.e., a re-assessment).

Prior to initiating the 2010 on-farm IRM assessments, seed company representatives and third-party contractors were trained on objectives and methodology. As in previous years, the training was conducted through a variety of mechanisms (e.g., face-to-face meetings and electronic presentations) and included the key elements of the assessment

program (e.g., IRM requirements, IRM assessment form, messages to growers, and follow-up actions).

Each registrant used a similar IRM assessment form. The introduction and company-specific sections of the form were customized to suit the needs of each registrant but the actual grower assessment questions were consistent across registrants. During the on-farm assessment, all similar product types were taken into account when determining if the farm was in compliance. For example, if it was determined that a grower had planted a stacked Bt corn product of the company conducting the assessment, then ALL stacked Bt corn products planted by that grower (i.e., stacked Bt corn products of other companies) were taken into account when making the determination of compliance. Completed assessment forms were submitted to a representative of the registrant for documentation.

Registrants responded to all compliance deviations identified in 2010 according to the common set of standards outlined in the Phased Compliance Approach. Examples of materials used as part of this follow-up process (e.g., educational material, warning letters and compliance assistance contact form) have been provided to EPA in previously submitted annual CAP reports. Names of the assessed customers were kept confidential by the registrant conducting the assessment.

2. Results

a. Results of First Time On-farm Assessments in 2010

As shown in Table 1, a total of 3,160 first time assessments were conducted in 2010 across the three product types. A total of 488 of these assessments identified non-compliance with the product type refuge requirements, and 277 of assessments had a deviation that met the definition of significant as defined in each individual registrant's compliance assurance programs.

Assessments were randomly conducted across a range of farm sizes, with approximately one-third of the growers categorized as "smaller growers" with less than 250 acres of corn. As with previous years, the data suggests that farm size should not be a selection criterion when trying to identify non-compliant growers.

Table 1. 2010 Results of first-time on-farm assessments

Product Type	Number of Assessments	Number of Assessments Representing Non-compliance	Number of Assessments Representing Significant Non-compliance
Corn borer-protected Bt corn	830	111	70
Rootworm-protected Bt corn	58	9	7
Stacked Bt corn	2,272	368	200
Total	3,160	488	277

b. Results of On-farm Re-assessments of Growers Found to be Out of Compliance in 2009

Growers found to be out of compliance in 2009 were re-assessed in 2010. A total of 510 assessments indicated grower non-compliance at the product type level in 2009 (Table 2). Of the 510 assessments that indicated grower non-compliance, 339 met the definition of significant non-compliance. All compliance deviations were responded to in accordance with the Phased Compliance Approach, including re-assessment in 2010. According to EPA requirements for growers found to be significantly out of compliance two years in a row, one of the growers re-assessed in 2010 met the criterion for revocation of access. A small number of the growers re-assessed were no longer farming or did not plant Bt corn in 2010.

Table 2. Annual Results of On-farm Re-assessments

Product Type	Number of 2009 Assessments Representing Non-compliance	Number of 2009 Assessments Representing Significant Non-compliance	Number of Revoked Licenses in 2010
Corn borer-protected Bt corn	177	117	1*
Rootworm-protected Bt corn	34	29	0
Stacked Bt corn	299	193	1*
Total	510	339	2

* One grower was found to be significantly out of compliance two years in a row for two unique product types

c. Discussion

As intended, the on-farm assessment program found a number of growers across all product types to be out of compliance in 2010. All of these non-compliant growers are receiving additional IRM education materials and individual assistance and will be re-assessed in 2011. In 2010, the registrants used Bt corn penetration and target pest pressure data in an effort to improve the efficiency and effectiveness of the compliance assistance efforts (i.e., correct as much non-compliance as possible in areas of highest risk). Beginning in 2011, the registrants will supplement this focused approach with additional tools (e.g., sales data) in an effort to identify as many non-compliant growers as possible. Once the focused approach is fully implemented, the registrants will regularly review and revise the approach as necessary.

Growers found out of compliance in 2009 were re-visited in 2010. Although a small number of growers did not plant Bt corn from the company conducting the follow-up, and therefore could not be re-assessed, the majority of growers re-assessed were found to be planting an appropriate refuge. In accordance with the criteria for grower license revocation, one grower will be denied access to the investigating company's technology for the 2011 planting season. The Phased Compliance Approach has again proven to be an effective mechanism to correct individual instances of non-compliance.

As with previous years, growers identified a number of refuge implementation challenges through the on-farm assessment process. The primary reasons for non-compliance provided by growers in 2010 were similar to those provided in previous years:

- Weather-related issues (e.g., rain prevented the grower from planting planned refuge)
- General awareness (e.g., grower misunderstood/unaware of refuge requirements)
- Dealer-related issues (e.g., refuge seed not delivered, preferred non-Bt hybrids not available)
- Inadvertent grower errors (e.g., refuge size miscalculations, planting errors)
- Logistical issues (e.g., small Bt corn field size and significant spacing between Bt corn fields made meeting refuge requirements for all fields a challenge)

These findings continue to highlight the need to enhance the refuge education program throughout the seed delivery channel as committed to by the registrants in the 2010 Bt corn registration amendments. The registrants are also optimistic that including the refuge size requirements on seed bag tags will address refuge awareness and understanding at the time of planting. Some issues identified by growers (e.g., refuge seed supply) must be addressed by individual registrants for antitrust reasons.

The 2010 on-farm assessments once again confirmed the trends identified in the grower survey that the majority of growers are making a good faith effort to plant a refuge. When out-of-compliance growers were approached individually as part of a compliance assistance follow-up prior to re-assessment, they were typically able to find ways to overcome challenges and plant the appropriate refuge on their farm the following year.

Section IV: Tips and Complaints

The registrants have developed mechanisms (e.g., customer service numbers) to receive information regarding alleged instances of non-compliance with the IRM requirements. The availability of these mechanisms continues to be communicated to growers, dealers, and sales representatives as part of the IRM education programs. In 2010, the registrants collectively received two (2) tips and complaints. Legitimate tips and complaints (as defined in Section 2.3 of the corn borer-protected Bt corn CAP) were managed in accordance with the CAP requirements. In other words, growers allegedly out of compliance who were identified as a result of a legitimate tip or complaint received an on-farm IRM visit, and growers found to be out of compliance during this visit were responded to in a manner consistent with the Phased Compliance Approach.

Section V: Publicizing the Compliance Assurance Program

The registrants have widely publicized the CAP, including the Phased Compliance Approach, which is common to all Bt corn registrations, to ensure growers are aware of the on-farm IRM assessment program and the penalties for non-compliance, including revocation of access to Bt technologies. The key elements of the CAP and Phased Compliance Approach are well integrated into each registrant's IRM education program, including company literature, internal training sessions, and meetings with growers and dealers. In addition, key stakeholder groups such as the National Corn Growers Association are educated by the ABSTC members and continue to inform their members of the CAP. Consistency of the CAP for corn rootworm-protected Bt corn and stacked Bt corn with the longer-established CAP for corn borer-protected Bt corn strengthens awareness.

Section VI: Conclusions

The compliance assurance programs for corn borer-protected, corn rootworm-protected, and corn borer/corn rootworm-protected stacked Bt corn continue to be effective. In 2010, the majority (69% to 76%) of growers surveyed planted the required size of refuge on their farms and the majority of growers surveyed (63% to 87%) planted a refuge within the required distance for all of their Bt corn fields. Furthermore, the survey

indicates that the vast majority of all Bt corn fields (82% to 94%) have an associated refuge. These findings are broadly similar to those in the surveys conducted over the previous 3 years when accounting for the margins of error. Overall, adherence to refuge requirements continues to be lower in recent years than historically observed for corn borer-protected Bt corn when this was the primary type of Bt corn available (2002 through 2006) and Bt corn adoption was much lower than it is today (i.e., more non-Bt corn available to act as a refuge).

A regional analysis of the grower survey results presented no clear differences in adherence to the refuge requirements between growers in the eastern and western Corn Belt. However, the growers in the southern cotton-growing region showed lower levels of adherence. Several reasons for lower adherence to the requirements in the cotton-growing region have previously been proposed, including practical limitations resulting from the larger refuge size required for corn borer Bt corn (50% refuge), smaller farm sizes, greater diversity and complexity in farm operations, a different pest spectrum, and the smaller role that corn plays in overall agricultural production. The 2010 survey also indicated that a greater proportion of growers in the cotton-growing region were unaware of refuge requirements, and fewer were able to recall the specific refuge requirements on an unaided basis. These findings present an opportunity for ABSTC and member companies to strengthen grower IRM education efforts in this region.

It is important to understand the biological relevance of non-compliance with the refuge requirements. Approximately 9 out of 10 growers surveyed planted some refuge for the Bt corn on their farms and the vast majority of Bt corn fields have an associated refuge (86% to 95%). These data suggest that the occurrence of significant areas of Bt corn planted without a refuge will be rare. When the refuge requirements were established, the EPA recognized that 30% (or higher) rates of non-compliance could be a reasonable expectation (page IID64 in US EPA 2001).⁹ In cotton-growing regions, Mexican corn rootworm is a pest only in very restricted parts of Texas and Oklahoma and does not have a history of insecticide resistance, while western and northern corn rootworm, European corn borer, and southwestern corn borer are generally sporadic, rare, or absent in this region.¹⁰ Corn earworm can be an important pest, but is known to have diverse hosts in this region and is highly dispersive; meaning that local selection pressure for resistance is of relatively low importance. Furthermore, the overall proportion of corn acres that are

⁹ EPA, 2001. Biopesticides Registration Action Document - *Bacillus thuringiensis* Plant-Incorporated Protectants. http://www.epa.gov/pesticides/biopesticides/pips/bt_brاد.htm

¹⁰ Steffey, K.L., Rice, M.E., All, J., Andow, D.A., Gray, M.E., and Van Duyn, J.W., 1999. Handbook of Corn Insects. Entomological Society of America, Lanham, MD, USA.

grown in the cotton-growing region is vastly less than in the Corn Belt. Cotton-growing states accounted for only around 10% of the total US corn acres in 2009 (USDA). Therefore, even though refuge implementation was lower in this region, the effect on overall selection for resistance was likely small. Resistance monitoring programs based on both field observations and population sampling continue to show that the key target pests of the Bt corn products remain susceptible to the insecticidal proteins.¹¹

The on-farm assessment program and the associated Phased Compliance Approach continue to prove effective at bringing individual growers found to be out of compliance back into compliance. Of the growers found to be significantly out of compliance in 2009, only one grower was found to be significantly out of compliance again in 2010 and will lose access to the investigating company's Bt corn technology for the 2011 growing season. Among 3160 first time assessments in 2010, 488 assessments found non-compliance with one or more refuge requirements, 277 instances of which were deemed significant. Some reasons for non-compliance provided during the assessments relate to individual misunderstanding or lack of awareness of the refuge requirements, while others relate to practical barriers at the time of planting, often weather-induced. Individual education and assistance visits will be provided to non-compliant growers, with the intention of correcting these errors and bringing all assessed growers back into compliance. However, these growers stand to lose access to the investigating registrant's Bt corn technology if they are significantly out of compliance again in 2011.

The registrations of the Bt corn products covered by this report were amended in September 2010 and the amended terms of those registrations included enhanced measures designed to improve compliance. An enhanced "Compliance Assurance Program" is being submitted separately by ABSTC, and the measures in this enhanced program are in large part responsive to the levels of adherence to refuge requirement for these products over recent years. These measures are designed to improve grower recognition and understanding of refuge requirements, while also improving the registrants' abilities to identify and correct incidents of non-compliance. Accordingly, it is anticipated that the number of growers identified as being out of compliance will increase during the first few years of implementation.

In addition to the education and communication activities required under the amended registrations and documented separately by ABSTC, specific education activities planned for 2011 by ABSTC and its member companies include an expansion of the "Respect the Refuge" education program launched recently in cooperation with the National Corn Growers Association (NCGA). This program involves mailings of postcards to all Bt

¹¹ Refer to ABSTC and individual registrant Insect Resistance Monitoring reports submitted annually to EPA.

corn dealers and growers and an expanded presence of billboards emphasizing growers' responsibilities in promoting the durability of the products and potential consequences of failure to plant required refuge. The registrants will also continue programs to train sales representatives on IRM principles and requirements, communicate with seed dealers on their responsibilities to educate growers on proper use of Bt technology, reference IRM in seed catalogs, seed bag tags, and promotional materials, and publish articles on IRM in seed company magazines, websites, and farm media. Collaboration with extension services and organizations such as NC205 and NCCC046 will be continued to develop targeted refuge communications via websites, newsletters, and media. These education efforts, through IRM/grower guides and other broad-based educational material on product-specific refuge requirements, will include: promotion of a "common non-Bt refuge" for both rootworm and corn borer pests to simplify refuge decision-making and management; promotion of multiple in-field refuge options that provide needed flexibility and facilitate compliance; an emphasis on in-field refuge options; and differentiation of refuge requirements of 20% in the Corn Belt and 50% in the cotton-growing region.

The recent introduction of new corn PIP technologies with different refuge requirements prompted ABSTC and its member companies to collaborate with NCGA to develop and distribute a new refuge calculator (www.irmcalculator.com). ABSTC member companies are actively promoting the calculator in several media formats (i.e. internal and external websites, grower mailings) in an effort to educate growers about the tool and to increase usage of the tool to plan their refuge acres. This new tool can be used with all commercial Bt products on the market and features a trait selection process that allows farmers to run several planting scenarios on a field-by-field basis. Its updated interface and clearer planting options conveniently shows growers the appropriate refuge for the various products on their farm.

Since 1996, US corn growers have become very familiar with the benefits of Bt corn technology. Growers are realizing improved productivity and reduced losses to insect feeding. Improved yields, enabled in part by this technology, continue to contribute to US agriculture's ability to meet domestic and export demand for corn used in food, feed and fuel production. Preservation of Bt corn technology is therefore of critical importance to US farmers and the registrants, and is in the public interest. An on-going IRM program that is effective in continuing the availability of the technology, while delaying and limiting target pest adaptation to Bt corn, is vital to the sustainability of these gains.